# NASA'S FUNCTIONAL TASK TEST: PROVIDING INFORMATION FOR AN INTEGRATED COUNTERMEASURE SYSTEM

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Exposure to the microgravity conditions of spaceflight causes astronauts to experience alterations in multiple physiological systems. These physiological changes include sensorimotor disturbances, cardiovascular deconditioning, and loss of muscle mass and strength. Some or all of these changes might affect the ability of crewmembers to perform critical mission tasks immediately after landing on a planetary surface. The goals of the Functional Task Test (FTT) study were to determine the effects of spaceflight on functional tests that are representative of critical exploration mission tasks and to identify the key physiological factors that contribute to decrements in performance.

The FTT was comprised of seven functional tests and a corresponding set of interdisciplinary physiological measures targeting the sensorimotor, cardiovascular and muscular changes associated with exposure to spaceflight. Both Shuttle and ISS crewmembers participated in this study. Additionally, we conducted a supporting study using the FTT protocol on subjects before and after 70 days of 6° head-down bed rest. The bed rest analog allowed us to investigate the impact of body unloading in isolation on both functional tasks and on the underlying physiological factors that lead to decrements in performance, and then to compare them with the results obtained in our spaceflight study. Spaceflight data were collected on three sessions before flight, on landing day (Shuttle only) and 1, 6 and 30 days after landing. Bed rest subjects were tested three times before bed rest and immediately after getting up from bed rest as well as 1, 6, and 12 days after reambulation.

We have shown that for Shuttle, ISS and bed rest subjects, functional tasks requiring a greater demand for dynamic control of postural equilibrium (i.e. fall recovery, seat egress/obstacle avoidance during walking, object translation, jump down) showed the greatest decrement in performance. Functional tests with reduced requirements for postural stability (i.e. hatch opening, ladder climb, manual manipulation of objects and tool use) showed little reduction in performance. These changes in functional performance were paralleled by similar decrements in sensorimotor tests designed to specifically assess postural equilibrium and dynamic gait control. Bed rest subjects experienced similar deficits both in functional tests with balance challenges and in sensorimotor tests designed to evaluate postural and gait control as spaceflight subjects indicating that body support unloading experienced during spaceflight plays a central role in post-flight alteration of functional task performance. To determine how differences in body-support loading experienced during in-flight treadmill exercise affect postflight functional performance, the loading history for each subject during in-flight treadmill (T2) exercise was correlated with postflight measures of performance. ISS crewmembers who walked on the treadmill with higher pull-down loads had enhanced post-flight performance on tests requiring mobility.

Taken together the spaceflight and bed rest data point to the importance of supplementing inflight exercise countermeasures with balance and sensorimotor adaptability training. These data also support the notion that inflight treadmill exercise performed with higher body loading provides sensorimotor benefits leading to improved performance on functional tasks that require dynamic postural stability and mobility.